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THE NEW MASSACHUSETTS INSTITUTE OF TECHNOLOGY

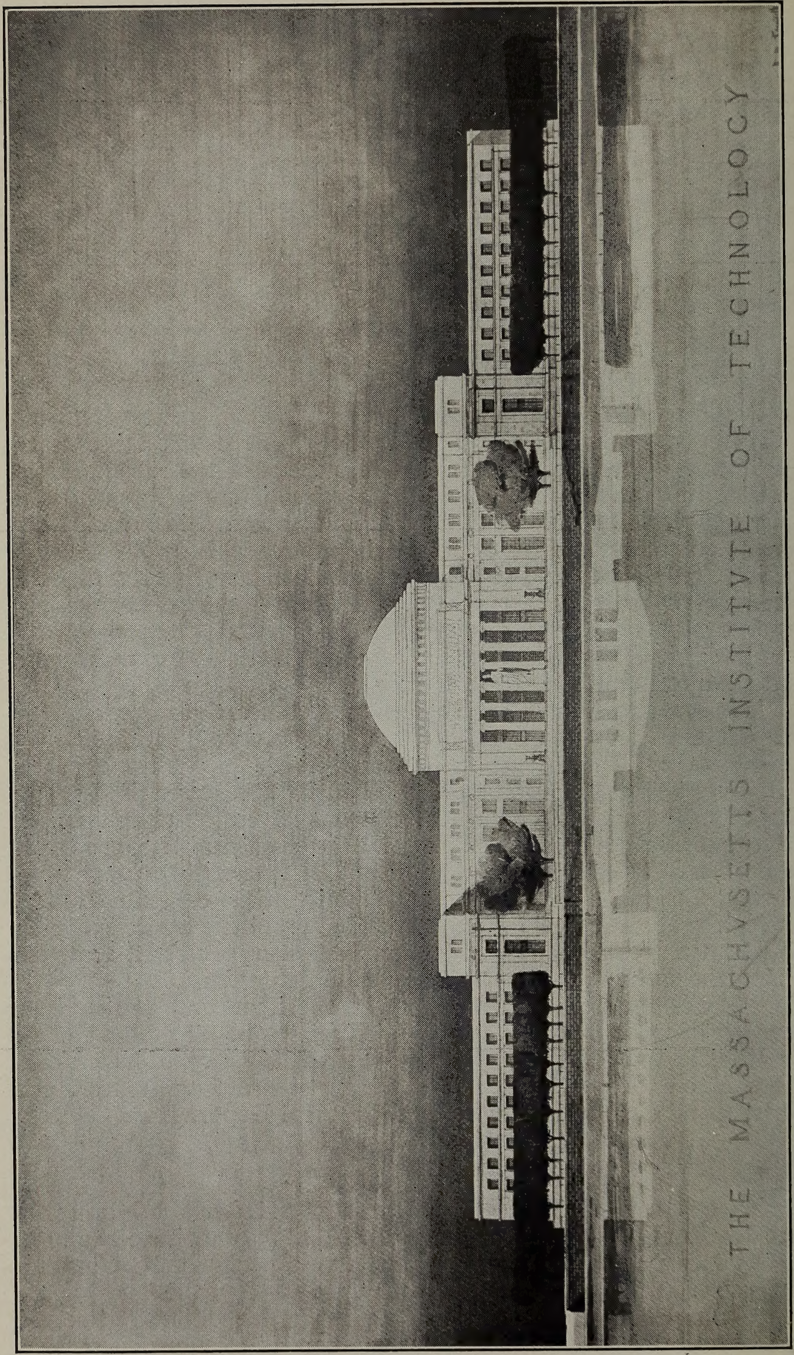
A short while ago the plans of the new Massachusetts Institute of Technology were first made public by President Richard C. Maclaurin. The casual observer is conscious of the magnitude of the vast undertaking, the engineering mind is engrossed with the many and varied problems that must be confronted in bringing the work to completion, and the aesthetician imbued with a devotion for architectural beauty and harmony cannot but be pleased with the artistic arrangement of this vast continuous assemblage of harmonious structures so delicately grouped, conceived and developed with artistic spirit and unity, and of that scholastic order which will relate the structures to their purpose.

In preparing the plans, the heads of the various departments were asked to prepare figures of what each one would wish if there were no other departments to be considered. In the same way a committee was asked to state the needs for student activities and with them the committee on athletics was requested to co-operate. There was thus secured a fundamental group of statistics, the space requirements for study rooms, lecture halls, laboratories and draughting rooms, together with those for administration, care and storage, and for the student housing and activities, and little by little during the past two years the demands have been compared and arranged so that the space needs have all been well determined.

The architect chosen to undertake the important work of the planning of these fifteen acres of buildings, to be all built at once, was William Welles Bosworth, a graduate of 1889, now of New York, who has had the constant aid and advice of Professor James Knox Taylor, head of the Technology Architectural Department.

New Tech Gifts

Since the fiftieth anniversary of the founding of the Massachusetts Institute of Technology in April, 1911, the Institute has been coming into its own. Shortly thereafter, the gift of T. Coleman DuPont, of half a million dollars with which to buy the land for the New Tech. proved to be the turning point, and the list of gifts and remembrances in the intervening two years is almost phenomenal



ELEVATION OF THE GREAT WHITE FRONT

and bears testimony to the high esteen in which Technology and its President, Dr. Maclaurin, are held. A list of the gifts follows:

Coleman DuPont	$ 500,000	for the land
Massachusetts	1,000,000	for maintenance
Mr. Smith	2,500,000	for educational buildings
Members of Corporation	250,000	balance on land
Bequest, Mrs. Rogers	600,000	unrestricted
Bequest, Mr. Green	600,000	scholarships, etc.
Anonymous	40,000	for engineering camp
C. W. Eaton	10,000	equipment of same
Pratt Bequest	750,000	Naval architecture school
Anonymous	500,000	for buildings
Anonymous	100,000	unrestricted
Alumni subscriptions	500,000	

In all they amount to $7,350,000. and there are bequests with conditions, namely, the Bartlett bequest, $100,000; the Weld be-bequest, of about as much, and that of Mary C. V. Speare of $5,000.

Much more will be necessary before the group can be completed, but work will continue in the meantime, and the matter of further financing is a problem still left for the future.

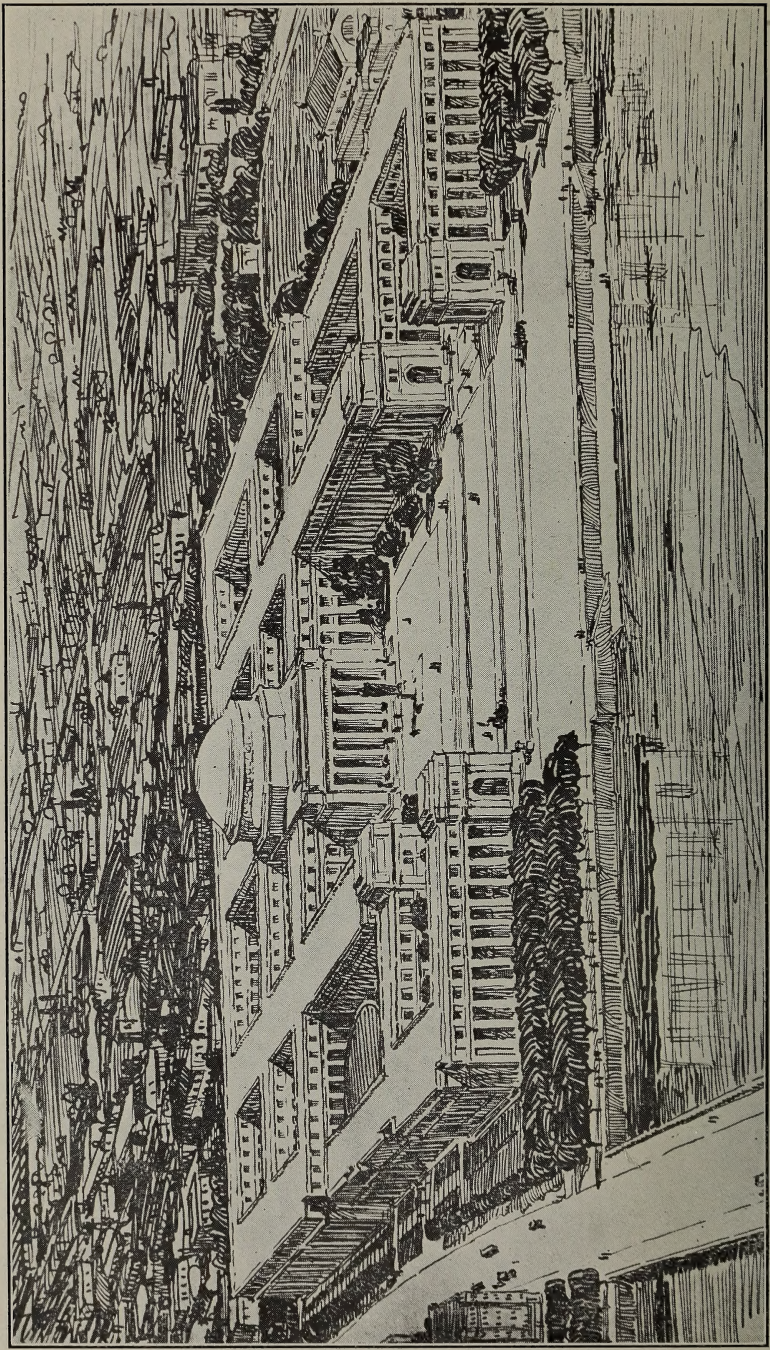
From the pictures anyone can gain for himself an idea of the magnificent proportions of this great white city that is soon to take its place on the Charles River Embankment. It will indeed be a white city as the picture suggests, and to a much greater degree, since the material selected for the exterior walls and facades is a white Indiana limestone, although, of course, the walls themselves will be of that great nineteenth century invention, re-inforced, or, as the latest nomenclature expresses it, armored concrete. The interior courts will be faced with light-colored brick.

There has never been selected heretofore a site comparable to this for an educational institution and technology is rising splendidly to meet the occasion. In the midst of the great metropolis of Greater Boston there has been established the picturesque Charles River Basin, a water park of hundreds of acres. Its embankments afford an unexampled opportunity for that municipal planning of architecture which is such a delight in European cities. Till now the opportunity has been practically unimproved. Technology will show what can be done.

At the best place on the Cambridge esplanade, to be commanded even better than now, when the proper bridge for the place shall have become possible, Massachusetts Tech. has secured its land and will itself erect monumental structures that will enhance its fair fame.

Forum - Like Court Approach To Library

From the river or the opposite shore the eye mounts the fifteen feet of the Esplanade wall, the treatment of which rests with the Metropolitan Park Commission. Under the circumstances it is easy to believe that no other than a dignified approach can here be



PEN SKETCH OF EDUCATIONAL GROUP OF BUILDINGS

possible to the great central court, which opens on the river. This rises in broad terraces of steps suggestive of the splendid stairways of ancient temples. Here the gradual uplift of the court leads the eye—and the feet if one is there—to the great colonaded portico of the modern temple of learning, the Library.

Above, the eye is caught by the masses of the buildings, which, rising step on step as they recede, converge their lines to the focus in the impressive Roman dome that surmounts the library.

Education Portion a Connected Group

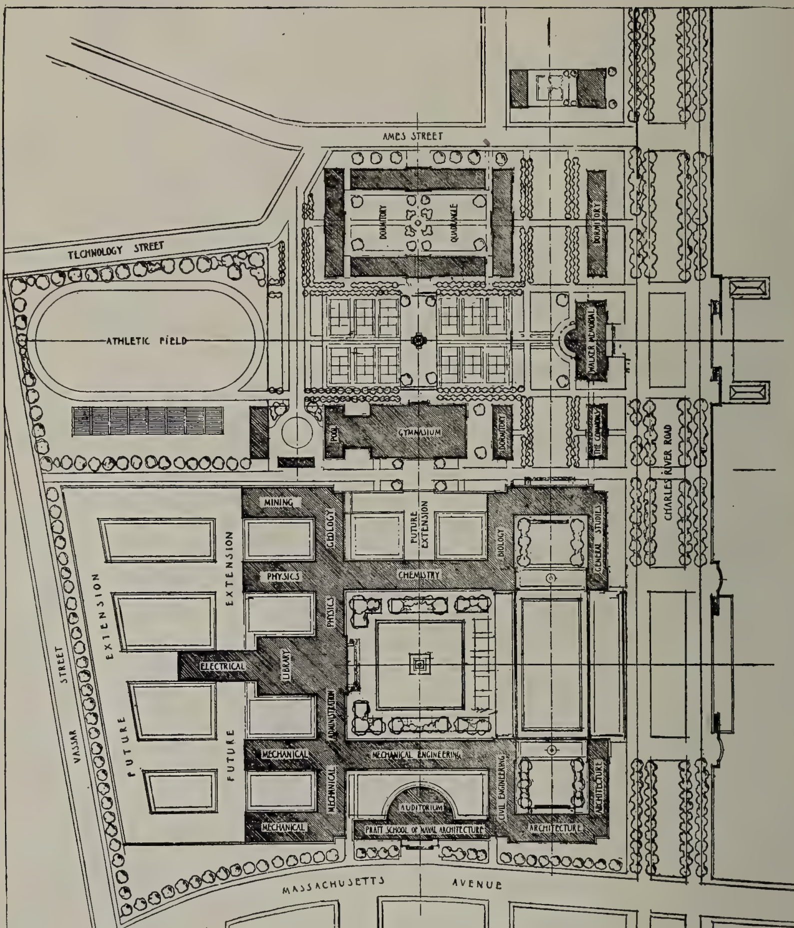
The educational portion of the New Technology may be described as a connected group of buildings, three and four stories in height, clustered about the library. The library is the central feature in the constructions as the book must be in education. And there is to be here the truest ideal of architecture, since the buildings express their purpose in every feature. The great dome rests on a vast structure whose pillared portico is ever an invitation to enter. It looks down on the court from a height of nearly two hundred feet, and is the dominant note in the composition. The central court, open to the river front expands into two large, though minor courts, when near the Esplanade. These openings with other courts interior to the buildings and not public, ensure the necessary lighting of the rooms. The public courts afford a most flexible means for development of the esthetic. Grass plots will be here and there with splashing fountains. Trees will accentuate the corners, the greenery of shrubs will relieve the classic architecture and convenient seats will invite the visitor to tarry a while in pleasant places. From the purely decorative point of view the opportunities are great, while the main quadrangle of nearly three hundred feet square affords the environment and place for some massive central figure or heroic sculptured group.

Classic Architecture with Pilaster Treatment

Mr. Bosworth has selected the pilaster treatment of the architecture as being most consistent with the needs of the work. Here light and air are the prime essentials and this construction permits the recesses to be almost entirely of glass. At the corners, to accent the masses are pavilions, which will satisfy the eye as to the stability of the structures. The whole is to be of classic order.

In the buildings nearest the river, which here present long facades, the pilasters will be two stories in height, with the third story really constituting the frieze. In the structures farther back there is a fourth story, which, being above the entablature, is in architectural phrasing as in popular, termed, attic.

It is this succession of buildings increasing in height from front to rear that is a distinctve feature of the New Technology, and furnishes grades and lines that converge towards the massive octagon from which rises the drum and its culminating dome. The dome is Roman in feeling and with its ever open eye of perhaps thirty feet



PLAN OF NEW
TECHNOLOGY BUILDINGS

across will assure the day illumination of the reading room beneath. The general architecture will be simple yet exceedingly dignified and refined, and will carry by these qualities and its magnitude and perfect proportions rather than by its ornament.

Courts Will Light the Study Rooms

The courts will be flanked by the department buildings and the latter are to be linked together so as to afford circulation throughout all portions of the vast structure. It will be unnecessary for the student to go out of doors in passing from one exercise to another, and he may thus avoid if he wishes the shock of going suddenly from a warmed room into the chill of wintry weather. The bother of coat or raincoat will be removed.

The comparatively narrow buildings will receive light from both sides and in addition it is planned to place all the draughting rooms on the top floor. Here, hidden by the parapets, there will be the standard saw-tooth skylights, and, as fortune will have it, the north is so placed that the skylight will run across the narrow dimension of the longer stretches of buildings.

Very Flexible Disposition of Departments

For the fundamental principle of interior construction there has been adopted a system of bays of uniform size, which may in a way be compared to the sectional bookcase in the home library. The floors will be hung on the walls entirely of the partitions. Rooms can then be made in any multiple of the unit merely by removing partitions, and since these support no floors, desired changes will be easy and inexpensive. Each department may in this way have its rooms precisely suited to its needs instead of modifying its needs to suit the limitations of its rooms.

Sectional Bookcase Architectural Planning

Besides expanding into adjacent room space, the plannings permit growth in much the same way as the sections of the library. There is in the layout as planned today, the chance of expanding the departments into future buildings, and the immediate constructions will afford the opportunity of erecting extensions or wings so that any department may expand into a building suited to its needs. And like the stacks of bookcase, this may be added usually in either one of two directions and with some departments, three directions of expansion are available.

This unique planning, the result of the careful consideration of the various technical men at the heads of the departments in consultation with the architect will provide for the future. The coming needs of any department, unknown as they may be today, can be met without disarranging any of the departments that have been established. This provision for the future will assure to the departments about twice as much space as they receive when Technology makes its move two years hence.

Magnificent Sight From the River

The picture that presents the elevation or view from the river, shows strikingly the splendid proportions of the whole group. It is not possible to give the proper depth to the court, but one must realize that the vast dome is back from the Esplanade about six hundred feet. But the dignified character of the whole composition is evident, the splendid proportions of the structures to the front, and the building up of the masses as they converge, and towering aloft, the splendid dome, within which Bunker Hill Monument, itself the wonder of its day, if it were set would manifest itself only by a few upper courses and the cap stone projecting through the "eye." There is no building comparable to this one in capacity in New England, excepting perhaps some of the great mill structures, and no other like it in architectural effect. The possibilities of the water front for decorative landings or a little ornamental harbor can not be overlooked, while the possibilities of the great central court can not be overestimated for display of the sculptor's art and the horticulturalist's skill.

Avenue and Embankment Fronts to be Built Now

The order of construction will care first for the prominent corners and buildings on the Esplanade, the front on Massachusetts Avenue and the buildings about the great central court. These from the moment of the moving of the school from Boylston Street to Cambridge will present the noble and dignified appearance that the plans suggest. What is to be done in the future in the construction of the educational buildings will be in the farther portions of the great estate, in extensions of departments or laboratories. This order of construction will avoid the exposure of unsightly inner fragments waiting to be hidden by outer buildings. New Technology will be pleasant to look upon from the moment of its opening. Practically together, the outer buildings will rise; they will be a proper and commodious housing for the Technology of today, and all together at one time the various departments will go to their new home. What they will need in the way of enlargement can be done quietly at future convenience and at comparatively low cost, for it will be interior work or on the side towards the railroad.

Student End of Plannings

Important as are the educational structures of the New Technology, they by no means comprise the whole of the plannings. Just as the educational courses look to it that the mind is broadened by literary studies in addition to those purely techincal, so the constructions will see to it that the social life of the young men is properly fostered. In the Technology-on-the-Charles the grounds have been cut squarely in two, and it is the eastern half that will provide for the out-of-school life and activities of the students.

A great grouping of buildings will stretch along the Esplanade for more than an eighth of a mile and of considerable depth behind which will be disposed the gymnasium and the athletic grounds. It

is estimated that these buildings when erected will call for three-quarters of a million. There is to be for the principal feature the Walker Memorial, near at hand the Commons, an enlargement of the present plan whereby many of the students get their meals at the Union, while dormitories will fill the space along the river and back to the great athletic field.

The Walker Memorial is a structure to be built as a memorial to the late General Francis A. Walker, a former president of the Institute, which is to be the nucleus about which the student life at the Technology will segregate and which might perhaps be best expressed as the club house for all the students. The architect may be depended upon to erect here buildings as well adapted to their purposes as are the educational buildings. The work will not begin at once, however, for at the moment the educational group has the right of way. It is sufficient of an undertaking to erect the fifteen acres of construction that will here be needed to house the enormous educational activities of Technology, so that the student buildings may wait a year or two till some of the more urgent of the others are out of the way. And again, while the Walker Memorial fund will perhaps erect the central feature in the group, here will still be needed other large sums for the gymnasium and other structures, for which the necessary funds are not yet in hand.

Here will be housed the many student activities, the Tech., which is the daily paper; Technique, the show; the Tech. Christian Association, etc., some thirty in number, with committee rooms and utilities.

It is estimated that the new gymnasium will call for one hundred thousand dollars and that it will be spacious—about forty thousand square feet in area. It is to be up-to-date in all its appointments, including correctional rooms for those students who cannot take the regular work. At Technology physical training is a part of the curriculum and failure to fulfil the requirements in this may be quite as detrimental in point of marks as failure in mathematics or chemistry. Gymnasium space, therefore, is required, and it is hoped to have the great floor with an area of fifteen thousand feet. The track, it is expected, will be thirteen laps to the mile. Outdoor athletics will be cared for by a great field in the rear of the grounds with a track of four laps, a 220 straight-away, provisions for the other sports and a fine grand stand.

Popular Comparisons

The floor space will be not far from twenty acres for the educational buildings that are now under construction, and these will make a Great White City of connected buildings lighted and ventilated by nine courts, which number will be increased by half-a-dozen more when the entire group is completed. The student who enters at one of the wings and traverses all the buildings once will have walked a mile and the floors placed end to end would make a way forty to sixty feet wide extending five miles.

If the buildings were set up on Washington Street (Boston), the great white river front would run from the Old State House to the

Old South Church (800 feet) including both, and all the intermediate buildings, while the block would extend towards the water so as to include the Custom House (1000 feet).

There will be one great court (360 feet square) in the very centre of the educational group, with an extension to the Esplanade out of which deploy two minor courts (160 feet square each). This affords from the steps of the library a view between the flanking buildings of about seven hundred feet to the Esplanade, which is itself two hundred feet wide.

One of the features that will interest engineers in the New Technology constructions is the fact that there will be about two and one-half acres of draughting rooms. These will comprise the top stories of all the departments excepting chemistry and general studies. The rooms will be roof-lighted by the saw-tooth skylight system, and in addition will have excellent side lighting, the buildings being in general sixty to sixty-five feet in width.

The distribution of space in the present general planning is an interesting matter, of which the following are approximately correct.

Architecture, 62,000 sq. ft.
Naval engineering, 35,000 sq. ft.
Electrical engineering, 50,000 sq. ft.
Public health and sanitation, 41,000 sq. ft.
Mining and Geology, 77,000 sq. ft.
Physics, 55,000 sq. ft.
Library and administration, about 30,000 sq. ft. each.
Civil engineering, 48,000 sq. ft.
Mechanical engineering, 176,000 sq. ft.
General studies, 52,000 sq. ft.
Chemistry, 70,000 sq. ft.

The floor spaces do not count those of the basement, which will be largely above ground, and altogether, total about million square feet, while the capacity of the united structures in the educational part that are to be finished at once, is not far from fifteen million cubic feet.

Samuel L. Trees is superintendent of the Whitby factory of the S. Trees Co. Ltd.

Edward F. Ball, '88, of 335 Warburton Ave., Yonkers, N.Y., is chief assistant engineer of resurveys for N.Y.C. & H.R.R.R.

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ALUMINUM*

E. A. Twidale, '14

History

Pliny tells us that "alumen" was the name of several kinds of salts used in dyeing. This name was probably derived from lumen, meaning light, due to the bright colors which they gave when used in dyeing.

After several experimenters had spent much time in an attempt to isolate the metallic base from alum, Sir Humphrey Davy at last succeeded in 1807. He passed a current through fused alumina and potash and got a mixture of aluminum and potassium which he was unable to separate. Wary called this metal "alumium," but later changed it to "aluminum."

In 1827 Wohler made aluminum by reducing an aluminum salt with potassium but only succeeded in obtaining small amounts of a grey powder alloyed with potassium. In 1845 he repeated these experiments which are described in his own words as follows: "I took for the operation a platinum tube in which I placed aluminum chloride and near it some potassium in a platinum boat. I heated the tube gently at first, then to redness. After cooling, the tube or crucible is put in a vessel of water. The metal is obtained as a grey metallic powder, but on closer observation, one can see, even with the naked eye, small tin white globules, some as large as pin-heads." Wohler determined the specific gravity of some of these globules as 2.5 and 2.6, which results are remarkably accurate.

St. Claire Deville in 1854 made the next step in the commercial preparation of aluminum. He employed sodium instead of potassium, and as early as 1855 made some ingots which were badly alloyed with copper. His next process was to mix sodium aluminum chloride with cryolite and small pieces of sodium and throw the whole mass on the hearth of a reverberatory furnace. The reaction continues for about fifteen minutes, after which the furnace is heated. At the end of three hours the molten metal is tapped off. Metal made by this process sold for $9.00 per pound and was the first to be used commercially. Castner cheapened the production of sodium to such an extent that in 1890 aluminum could be produced for $1.25 per pound by this method. About this time the electrolytic process was introduced which soon replaced Deville's process.

From 1807 when Davy obtained an alloy of aluminum and potassium by electrolysis of fused alumina and potash investigators had been experimenting extensively on the electrolytic production of aluminum. Many methods were tried out for the electrolysis of cryolite and of a mixture of fused chlorides, but they all proved too expensive to compete with Deville's process. In 1886 Hall made aluminum by a process essentially the same as that used to-day which is described in his own words as follows:—"It occurred

*Read before the Industrial Chemical Club, December 1st, 1913.

to me that if I could find some stable solvent for alumina itself, which at a reasonable and practicable temperature would dissolve the alumina by the mere mingling of it with the solvent and allow the alumina so dissolved to be electrolyzed out of it, leaving the solvent unaffected, this would be the best process which could be devised for the manufacture of aluminum by electrolysis." He tried several solvents, but finally used cryolite in a carbon lined crucible with perfect success. Heroult in France discovered the same process just a few months later than Hall.

Manufacture

SOURCES OF ALUMINUM: It has been calculated that 7.8 per cent of the earth's crust is aluminum, the next metal in abundance being iron, which constitutes only 5.4 per cent. Aluminum is the main constituent of most clays, bauxite, cryolite, corundum, feldspars, etc. Bauxite and cryolite chiefly, are used at present on account of their purity, but during the last year several processes have been patented for the extraction of alumina from clay, which may render this the main source of aluminum supply in the future.

BAUXITE $Al_2O_3.2H_2O$: As is shown by the formula, bauxite is a hydrated aluminum oxide. The aluminum is always more or less replaced by iron and also contains a certain amount of silica. Large deposits occur in France (used by the British Aluminum Co.), Ireland and Austria. In America it is found in Alabama, Georgia and Arkansas (used by the Aluminum Co. of America). Bauxite contains about 50% to 60% alumina.

CRYOLITE $Al_2F_6 . 6Na F$: Cryolite is found almost entirely in Greenland, and although it was first used for its soda in soap making, it is now almost wholly used in the aluminum industry.

Before bauxite can be used in the electrolytic bath it must be purified and dehydrated, Baye's method being most largely used at present. The crude bauxite is slightlty ground and calcined to destroy organic matter, and is then agitated with a strong caustic soda solution under pressure for two or three hours. The liquid is then diluted considerably and the silica and iron oxide are filtered off. The solution of sodium aluminate containing alumina and sodium oxide is agitated for thirty-six hours with a little hydrated alumina, which throws down 70% of the aluminum hydroxide. This hydroxide is filter pressed off, washed, dried, and ignited at 1000°C. The result is nearly pure alumina and is ready to be used in the aluminum pots.

There are several new processes for the recovery of alumina from clay, the most important being those of Dr. S. Peacock, Childs and Cowles. Cowles believes that his process will cheapen aluminum four or five cents per pound.

ELECTROLYSIS: The actual electrolysis is carried out in carbon lined "pots," which are made of three-quarter inch plates rivetted together in the shape of a box about 2 feet by 5 feet by 9 feet in dimensions, the pots themselves each forming one electrical connection. A hole is provided at one end for tapping. These pots are

lined with a mixture of ground coke and tar, which is tamped in hard, leaving a cavity on the tap hole. The pot is then baked until the lining is hard and firm. This lining forms the cathode while the anode is composed of about 60 carbon rods three inches in diameter into each of which is screwed a metal connection which is securely clamped to the copper bar carrying the current.

The operation of the pots is very simple. They are filled with an electrolytic bath in which alumina is dissolved and then decomposed by the electric current giving aluminum. The bath is a mixture of cryolite aluminum flouride, and calcium flouride, but varies somehwat in the relative proportions of the various constituents. The powdered "ore" is thrown on the top of the bath, and after standing for some time is stirred into the bath which dissolves about twenty per cent. of the alumina. There is a lamp in parallel with each pot which will light if the resistance gets too high, thus giving a check on the amount of ore necessary to be added to maintain the proper resistance. A current of 10,000 to 12,000 amperes flows across each pot between two electrodes with a drop of 5 to 10 volts. The pots are tapped once a day, each yielding about 150 pounds of metal at each tap, which is cast into pigs or "waffle plates" in cast iron moulds.

The electrode consumption is large, as all the oxygen liberated by the electrolysis combines with the carbon anodes and burns as carbon monoxide. The copper used in copper alloys is added directly to the pots.

The metal from the pot room contains a certain amount of alumina as "dross," which is removed by smelting in small coke fired reverbs and skimming it off the top. The metal is tapped out of these reverbs into crucibles and is cast into ingots in iron moulds. Much care must be exercised in the pouring to insure sound ingots, about two to three minutes being required to pour an ingot of about 60 pounds.

Industrial Uses

Aluminum is very light, has a beautiful silvery appearance, is very ductile and malleable, being capable of being cast, rolled, drawn, machined, forged, hot or cold, stamped, spun or polished. It does not tarnish or corrode when exposed to the air and is unaffected by immersion in water. It has a most remarkable effect on steels and yields with other metals, principally copper, zinc and manganese, alloys of great industrial importance. Its properties as a conductor are such that it seems destined to become the great rival of copper in electrical transmission.

Alloys: About ⅛ to ¾ pounds of aluminum per ton of steel, added in the ladle produces several good effects on the steel as follows:—

(1) Increase in soundness of ingot tops (less scrap).
(2) Quieting ebullition in steel.
(3) Prevents oxidation and increases homogenity of steel.
(4) Increase of tensile strength.
(5) Removes oxygen and oxides similarly to manganese.

Aluminum does not form alloys of any importance with steel, its value being due simply to the fact that it renders steel sounder and less liable to blow holes.

Alloys with copper are much harder than pure aluminum. There are two classes of copper alloys, those containing up to 11% aluminum and those containing up to 15% copper. Between these ranges the alloys are brittle and not reliable. Aluminum bronze contains 10 to 11% aluminum and can be easily soldered, not presenting the same difficulties as the pure metal. Aluminum copper alloys are those most generally used, especially when a stronger metal is required as in most castings. A proportion of copper ranging between 7% and 10% gives an alloy with a tensile strength of 15,000 to 20,000 pounds per square inch.

Aluminum is now universally used in galvanizing baths (about 1 lb. of aluminum per ton of bath) to make it more fluid and to cleanse it of impurities.

Aluminum also alloys with all other metals such as manganese, magnesium and more particularly nickel and zinc, which, however, are not so widely used as the copper alloys.

Conductors: Aluminum has been used very extensively as an electrical conductor, a great many of the big transmission lines using it for this purpose. Although aluminum will conduct only 60 per cent. of the current which a copper conductor of the same cross section will carry, yet since copper is nearly three and one-half times as heavy as aluminum it follows that for equal conductiveness, copper is twice as heavy as aluminum and at present prices 30 per cent. more expensive. When the conductor must be insulated, the lesser surface of copper renders it the more economical, but for bare high tension lines aluminum is the more desirable. It is unaffected by moist air, towers can be spaced farther and built lighter. The wind stress and ice load are, however, higher on aluminum than on copper. Another advantage is due to the fact that the corona discharge on a high voltage line is kept down when a large conductor is used. This corona discharge occurred at a certain critical voltage and limits the voltage that can be used. Tests have proven that aluminum of the same capacity as copper will take a higher voltage before the corona discharge will start.

There are several methods of joining aluminum cables which do away with the trouble in soldering. A joint made by the Northern Aluminum Co. consists of a sleeve that is compressed by a small portable hydraulic press. The ends may have a sleeve threaded for a right and left hand stud and sometimes a torsion sleeve joint is used.

Aluminum is also useful for bus bar work on account of its lightness. At Niagara Falls there is a bus line reaching from the power house below the bank to a factory above, a total distance of 350 feet. This line carries 40,000 amperes and being of aluminum is cheaper and more easily supported than a copper line of equal capacity. Aluminum is not used much for small conductors on account of difficulties in soldering.

Automobile Construction: There is little doubt but that the

rapid advances in the automobile industry are largely due to the increased use of this metal, since it is made in all manner of shapes for auto construction. Rolled shapes are used for door plates, floor edges, etc.; washboards on all the better cars are of aluminum and tread plates and running boards are now almost always of this metal. For crank eases, gear boxes and other parts of a gas engine aluminum has no equal. Weight for weight it is twice as strong as cast iron and not so liable to fracture from shock.

COOKING UTENSILS: Perhaps the use of aluminum with which we are most familiar is in the form of cooking utensils. The metal is not attacked by organic acids and its salts are colorless and non-poisonous. It will not chip like agate ware and is a much better heat conductor. Aluminum utensils last practically forever and are very easily cleaned although it must be noted that soda must not be used for this purpose.

CHEMICAL PLANTS: Aluminum is extremely valuable as a metal for use in chemical industries where corrosive substances are handled, since it is attacked only by hydrochloric acid and alkalies. Owing to the colorless and non-poisonous nature of its salts it can be used for a crystallizing apparatus and for kettles used in making food stuffs. Owing to its resistance to corrosion by stearic acid, etc., it is used extensively in the soap industry. It has been used for some time in brewing for fermenting vats. The metal can easily be made into pipes and is valuable for some cooling apparatus.

THERMIT: Aluminum finds a large application in thermit, which is essentially a mixture of aluminum powder and iron oxide which when brought to a high temperature by a starting powder combine forming molten iron and alumina. This molten metal is formed at white heat and can be used for making welds and repairing castings, shafts, etc., which could not be accomplished by any other means. It is claimed that pipes can be welded cheaper than it can be coupled with flanges, while the joint is permanent and never leaks. Thermit is practically indispensable where a quick sound repair is needed.

OTHER USES: The Manchester Armature Repair Co. make field coils of aluminum wire which has had its surface oxidized and uses no insulator between the coils other than this oxide. Asbestos or some other insulator is used between coils where the voltage is great. The chief advantages claimed for these coils over those of copper are:—

(1) They are better heat conductors, hence the coils keep cooler.
(2) The insulating film is unaffected by heat moisture or vibration.
(3) The weight is less than one-half that of copper.
(4) The oxide insulation does not deteriorate like organic insulations.
(5) The aluminum has greater durability and a smaller first cost.

These coils are used to some extent on the continent and will, no doubt, be in use in this country soon.

Aluminum can be made into rivets, screws, nails, etc., much cheaper than can copper and it does not discolor the woodwork as copper does. Aluminum foil is displacing tin foil for a great many purposes and aluminum powder, made from small pieces of foil is used in paints where it has displaced silver. The British Aluminum Co. make a high explosive called ammonal which is a mixture of ammonium nitrate and aluminum powder. It has not the propelling effect of dynamite, its explosion being too rapid, but its action can be modified by varying the composition from a slow explosive to one of great shattering power. There is absolutely no danger of explosion by shock or fire and the remaining gases after explosion are entirely harmless. Aluminum also finds some use as anodes in electrolytic rectifers or "Nodal Valves." If an alternating current is passed through a salt solution using aluminum electrodes, the current can only pass one way and come out as a direct current. The same principle is made use of in lightning arresters, where the oxide film will stand up against the voltage designed for, but will break down to ground in case of a sudden increase.

Working Aluminum

Casting: Pure aluminum shrinks considerably in cooling and is so soft that its copper alloys are nearly always used for casting. These alloys shrink about 15 inches per foot. The metal should be heated very little above its melting point and the dross thoroughly skimmed off. The pouring must be done as slowly as will give a sound casting and large gates and risers should be used. Green sand cases can be used and the mould should not be packed too tightly. By observing carefully these differences from brass casting, first-class castings may be obtained.

Machining: Aluminum machines considerably like brass, but the tool can be operated faster. Some good lubricant should be used.

Soldering: Aluminum offers several difficulties in soldering. Owing to its high heat conductivity, the joint is kept cool, while an invisible film of oxide surrounds the metal. However, by heating the metal quite hot and mechanically removing the oxide a successful joint can be made. The bar or wire to be tinned is kept hot by pouring molten tin as solder over it and heating with a blast lamp, while the oxide is best removed by scratching with a jewellers' scratch brush. Once the metal is tinned, soldering offers no difficulties.

A new patent for soldering aluminum uses a mixture of 3 parts tin chloride and 1 part zinc chloride, which mixture is heated to expel H Cl. On cooling, a little tin dust is added. To tin the surface it is coated with paste and heated below redness. When the proper temperature is reached the aluminum is coated with the oxides of tin and zinc, which on removal with a brush leave a bright film of tin. The soldering then becomes as simple as that of tin.

Welding: Rods up to 2 inches in diameter are easily welded by squaring the ends up and heating with a blow lamp until the ends

begin to soften, when the rods are pressed together and the oxide squeezed out.

Sheets may be quite easily welded by carefully cleaning the edges, butting them together and playing an oxyocetylene flame along the seam using a suitable flux. This method will make a perfectly homogenous joint.

Properties

Atomic Wt.	27.1	Sp. Gr. (Cast)	2.6
Melting point	657°C	Sp. Gr. (rolled)	2.71
Melting point	1215°F.	Tensile strength—lbs sq. in (copper alloy)	20,000—30,000
Thermal cond. (Ag. = 100)	31.3	Modulus of elasticity pds. sq. in.	9,000,000
Electrical cond. (Ag. =100)	58.5	Spec. Res. in micro ohms) hard	2.884
Coeff. of increase of resistance per increase in temperature of 1°C	.0032	per cm. cube at 60° soft	2.827
Sp. heat	.218	Latent heat of fusion	28.5 Kg. Cals.
Coeff. of linear expansion per °C	.0000234		

H. R. Hill, B.A., Sc., '11, is cost engineer for the Toronto Hydro Electric System, Toronto.

T. L. F. Rowe, '11, is structural engineer on the erection of the Hospital for Insane, Whitby, Ont.

F. A. Robertson, '08, is inspecting engineer in the sales department of the Canada Cement Co., Limited, Toronto.

R. G. Lee, '10, is assistant sales manager for the Toronto Hydro Electric System.

L. W. Rothery, B.A., Sc., '11, is erecting engineer for Allis-Chambers Mfg. Co., Milwaukee, Wis.

S. E. M. Henderson, '00, is sales engineer for the Canadian General Electric Co., Peterboro, Ont.

J. A. Stiles, B.A., Sc., '07, is dean of the faculty of applied science and engineering in the University of New Brunswick, Fredericton, N.B.

H. R. Mackenzie, B.A., Sc., '13, is inspecting engineer for the Board of Highway Commissioners of Saskatchewan at Regina, Sask.

G. R. Elliott, B.A., Sc., '11, is with the hydrographic surveys branch of the Department of the Interior, at Calgary, Alta.

S. B. Iler, '08, is assistant engineer with the Brantford Hydro Electric System, Brantford, Ont.

W. A. A. McMaster, B.A., Sc., '08, is a member of the firm McMaster & Christie, surveyors, McKay & Adam Block, Prince Albert, Sask.

TWENTY-FIFTH ANNUAL DINNER

The twenty-fifth annual dinner of the University of Toronto Engineering Society, held in the engineering building, on Friday evening, December 5th, in honor of our esteemed Dean Galbraith, will always command a prominent place in the history of the University. Six hundred of the Dean's loyal followers assembled from all parts of Canada and United States to pay tribute to the founder and builder of the "School" and one of the leading builders of our rapidly growing Dominion. That hundreds of others regretted exceedingly their inability to be there in person, and

FIRST NATURAL SCIENCE CLUB OF THE UNIVERSITY
J. Galbraith W. H. Ellis W. Mitchell H. H. Ross
F. C. Spencer J. H. Hughes C. M. Grover C. W. R. Biggar C. P. Atkinson

were really there in thought and spirit, was evidenced by the continuous inflow of congratulatory telegrams to the Dean from all parts of the continent. The banquet was the greatest ever held by any organization of the University, not because of the mere numbers present, but because of its import. The loyal and unbounded respect manifested by the earlier graduates for Dean Galbraith aroused even greater admiration in the hearts of the more recent graduates and the undergraduates who have not been so fortunate as to enjoy the intimate association with him as did the students of the smaller classes in the earlier days of the institution.

With a vision unparalleled in the history of the University, Dr. Galbraith has raised a monument in the record of engineering education. Faced by opposition and lack of funds, with true engineering ability, he adapted the available material in his possession to make a beginning, which soon dispelled all doubt of the practicability of engineering education—for in those days there was none. Step by step the stones were laid—and always under the same guiding hand—until to-day we have the "School," unsurpassed by any engineering college in the world.

The success of Dean Galbraith's every venture in life, preponderous as some of them have been, is due not only to his exceptional ability, his careful weighing of problems and his keen insight, but also to the fact that he was a man among men; one who understood human nature and appreciated the worthy qualities in every man. He not only won distinction at the University as a student, winning the Prince's prize, but was also active in the various University organizations. He was one of the organizers of the first Science Club of the University, a photo of which club appears opposite.

After graduation he always received the respect of the men on any construction work of which he had charge. During his exploration trips in New Ontario he won the highest admiration of the Indian tribes with which he came in contact. The Indian guides whom he employed to assist him on his canoe trips through the new country did not fail to show their appreciation of his kindly nature. Even the chiefs of the Indian tribes were always at his service and as a consequence he was always favored with the most reliable guides that could be furnished him. It will no doubt be interesting to our readers to learn something of his most celebrated friends among the red men. An Ojibway chief, Peter Jacobs, perhaps deserves special mention. Peter was a man of considerable reputation. He visited England and was favored with a personal interview with Queen Victoria. In talking with the Duke of Wellington he displayed a great deal of interest in that grand English hero but nevertheless his impressions may be very well summed up in his own words to the Duke, "You great big chief, you honored chief of white tribe, but only thing me envy is you' Roman nose." This same Peter Jacobs was once stranded in New York without any money with which to get home. True to his Indian resourcefulness, he did not give up but painted up some loafers as Indians and by advertising for a certain company he succeeded in earning enough money to bring him home.

On one occasion the Dean and his guide, an Indian chief named John Peters, while on a canoe trip, camped for the night quite near the encampment of Peter Jacobs and several others. During the celebration of their meeting again with their old friend, Peter Jacobs and John Peters agreed to give John Galbraith an Indian name, the best which they could give him. After

a consultation in the light of the Indian camp fire they decided to call him "Nawaquekijig" (the noon-day sun). That night, with the starry sky for a roof and in the solitude of the northern forests, in the midst of a circle of ardent admirers, Dean Galbraith was christened Nawaquekijig. Peter Jacobs, with all reverence, lifted a mug of fire-water above their white friend and sprinkling a few drops upon his head, pronounced him a member of the tribe, and forthwith proceeded to drink the remainder in celebration of the occasion.

Later on, when the Dean met the Cree tribes, they already knew him by his Ojibway name and they, being equally anxious to manifest their high regard for him, decided to give him a

THE DEAN (in centre) WITH INDIAN GUIDES

Cree name. Not having a word which exactly meant noon-day sun, they chose one approaching it as nearly as possible, viz., "Apitatchisikan," meaning "half-day."

The broad-minded, true-hearted and straightforward nature of Dean Galbraith has won the respect of all who know him and has played no small part in placing him among the leading men of our Dominion. While President Mechin and his executive are to be congratulated upon the excellent organization and their unceasing efforts in connection with the banquet, we must also realize that the true realistic success of the dinner was due

to the spontaneous response from graduates and undergraduates alike upon learning that the Dean was to be the guest of honor. The predominant sentiment which pervaded the whole assemblage must be attributed to the confidence and admiration which the Dean's integrity of character has created in the hearts of his followers and colleagues. Every class since 1881 was represented. Practically every centre in Canada was represented and also many places in United States, including New York, Pittsburg, Madison, Cleveland, Cincinnati and Buffalo. The loyal men of Montreal sent down a delegation of sixteen, while Ottawa, Regina, Winnipeg, Port Arthur, Sault Ste. Marie, Hamilton, Temiskaming district and dozens of other places were well represented.

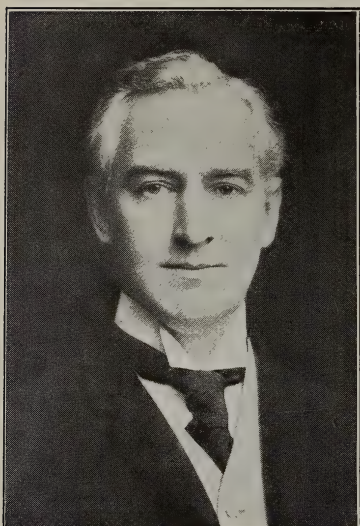
Class '08 had a most successful re-union on Thursday, Friday and Saturday which assisted considerably in making the annual dinner a success. As a result of the efforts of the class executive and the class secretary, P. R. Brecken, over fifty of them were gathered together to renew old associations.

The graduates from a distance continued to pour in during the forenoon and after many groups had lunched down town, they proceeded to the Engineering building, where an old time Engineering Society meeting was held in the orignal meeting place of the society and was presided over by the first president of the society, Dean Galbraith, and was officered by some of the first officers of the society, Prof. C. H. C. Wright, Prof. H. E. T. Haultain, B. A. Ludgate, G. H. Duggan and T. K. Thomson. This proved to be a bright spot in the week-end re-union and reminiscences were freely and enjoyably indulged in.

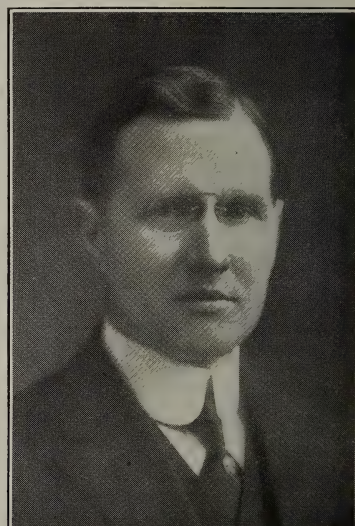
When all were seated in the banquet hall, the Dean, accompanied by G. L. Morris, '81, and G. H. Duggan, '83, entered. The demonstration which ensued will not soon be forgotten by those who were present. He paused for a moment, almost timidly, at the threshold, before the waving multitude of handkerchiefs, while every eye was directed toward him and every voice rang loud with cheer upon cheer for the grand old man who had merited and won the deepest affection of those assembled. Then he proceeded to the head table to accept his place as the guest of the evening. The speeches of the evening all reverted to the persevering patience of and high ideals of the Dean which made it possible for him, in the face of almost insurmountable difficulties, to mould and make an engineering school such as we have to-day. Many were the reminiscences which at intervals during the evening ascended buoyantly to the surface and illustrated the spirit which has dominated the engineering course since it was founded by Dr. Galbraith thirty-five years ago. The Toikeoikestra and the School Quartette added greatly to the evening's entertainment and several vocal selections by Mr. Fiddes and several recitations by Mr. LeRoy Kenney were well rendered and much appreciated.

The toast to Canada, proposed by G. M. Smythe, '14, was responded to by Col. W. N. Ponton, of Belleville, in a very eloquent address, in which he reviewed the important part which the engineer has played in developing our Dominion. "This gathering," he said, "is just a re-union of father and his boys. Looking down upon this throng of men who have come from great distances and with much inconvenience, I cannot but admire your spirit of loyalty to your father who has instilled into you those first principles of character and thought, and I can see in my mind's eye hundreds of others of the "School" graduates in all parts of the earth regretting with heartfelt sorrow that they cannot be with you to do honor to their Dean."

The toast to the University of Toronto was proposed by



T. K. THOMSON, '86

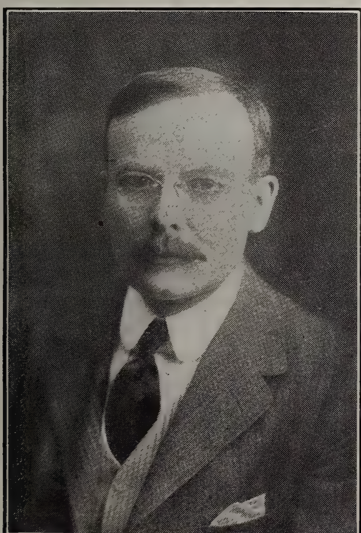


H F. BALLANTYNE, '93

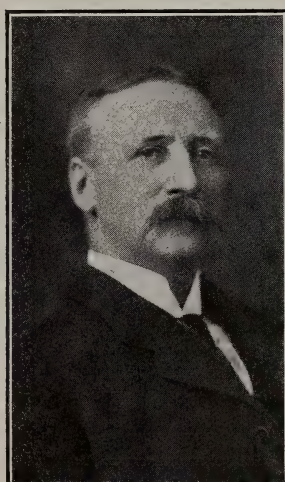
Eric Phillips, '14. In replying, President Falconer pointed out the value of the University in upbuilding the country. The real asset of a growing nation is the manhood, the integrity and the brawn of its people. He referred in most kindly terms to his regard and ours for Dean Galbraith, the man, above all others, who by precept and teaching had made possible in the faculty of applied science an atmosphere of integrity and uprightness, yielding results of untold value in this Canada of ours. Our University is young and our country is young. Our past is not a measure of our work and worth, but rather the broad and bright future which promises to be ours. The graduates of the University are everywhere doing their part in the moulding of healthy public opinion so vital to a growing country. What is

it that marks these men? It is not the association of a few years with a means of acquiring knowledge and training so much as a subtle spirit throughout their life, which marks them as having lived in a certain good atmosphere somewhat different from that of any other university. What is it that marks our engineering graduates to-day? It is not so much that they have received a certain amount of technical education as that they have lived in an atmosphere tempered by the strong and elevating personality of such a man as Dean Galbraith.

In proposing the toast of the evening, "Our Dean," Mr. Hyndman Irwin, secretary of the Toronto Engineering Alumni Association, struck the keynote of the evening and unfolded the predominant thought of every heart when he said, "The debt we owe to our Dean cannot be measured. He has taught us to



R. A. ROSS, '90



C. H. DUGGAN, '93

be men as well as engineers. As undergraduates we find him Dean of Engineering in the University and as graduates we find him Dean of Engineering in Canada. Although far above us, he is always one among us and there is scarcely a country on the face of the globe in which there are not those who would gladly be with us to pay tribute to the Dean, whose integrity and firm and sympathetic personality has won for him the highest respect of the many hundreds who are proud to claim him as their chief adviser in their engineering work.

The outburst of enthusiasm when the Dean rose to reply to this toast was sufficient evidence that Mr. Irwin in his well chosen remarks had expressed the sentiment of the entire

assemblage. It is a certainty that the "School" walls cannot recall a more vigorous and enthusiastic "Toike-oike." With his usual modesty the Dean thanked those present for the honor they had done him and tried to disclaim much of the credit which had been accorded him. In his early boyhood days at Port Hope he had often amused himself in his father's back yard with many mechanical devices and soon acquired the art of careful observation. He had watched the surveyors at work with their instruments and pickets and chains and decided that he would like to learn that sort of work. Upon coming to the University he was disappointed at finding that no course in engineering was given and so he enrolled in arts. At that time (1863) engineering was but a trade and a person might after serving some apprenticeship present himself for examination by the University examiners and if his test proved satisfactory he would be awarded a diploma by the University. After graduation he spent much time in railroad construction and exploration work. In 1878, by reason of his personality and reputation, he convinced the authorities to have the School of Practical Science established, where engineering principles might be taught.

When the Dean had concluded his extremely interesting talk Mr. R. Laidlaw, '15, in a few well chosen words expressed the kind regard of the "School" men for Mrs. Galbraith, whose constant and cheerful assistance to the Dean in many ways, had contributed much toward the success of the "School." He asked the Dean to accept from the Engineering Society a boquet of flowers for Mrs. Galbraith. The presentation was made by W. G. McGhie, '15.

The toast to the Profession was proposed by Mr. O. G. Lye, '14. Mayor T. R. Deacon, '91, of Winnipeg, who had intended to reply to this toast, found at the last minute that he could not possibly come and in his absence Mr. R. A. Ross, '90, of Montreal, and Mr. H. F. Ballantyne, '93, of New York, consented to reply on short notice. It was pointed out by Mr. Ross that the broadening field of engineering leading as it now does to administrative work and to positions on commissions is an indication of the necessity of a broad training for the engineers of the future. However, the speaker felt that a profession, the members of which were trained by Dean Galbraith, could well take care of itself. Mr. Ballantyne indulged in some very interesting reminiscences of his freshmen days when Mr. Deacon, for whom he was substituting, helped to put him through the hazing ordeal and threw out a few hints to class 1T7 for their opening exercises next year.

With the singing of "Auld Lang Syne" the banquet was brought to a close about 1.30 a.m. and each and everyone present went away pleased that he had been able to share a part in the greatest event in the history of the "Old School." Among the

large number of telegrams sent from outside points were the following which came to the hands of the editor:—

From A. D. Campbell, '10, Secretary of the Temiskaming Alumni Association.—Temiskaming graduates desire to congratulate you on this your anniversary and extend to you every good wish for a continued prosperous career as Dean of Applied Science.

From N. R. Robertson, '06, Secretary Engineering Alumni, Vancouver.—The 85 members of the Engineering Alumni of the Pacific Coast congratulate Dr. Galbraith and wish to express

J. W. TYRRELL, '83

J. L. MORRIS, '81

appreciation of his untiring efforts in the service of the School and of our loyalty to him and the "Old School."

From E. H. Phillips, '00, Saskatoon Alumni.—Saskatoon sends heartiest congratulations to our Dean.

From E. B. Merril, '91, Chairman Moose Jaw Alumni.—The School men of Moose Jaw desire to join those present at the annual banquet in doing honor to Dean Galbraith.

From Geo. L. Brown, '93, Morrisburg, Ont.—Regret inability to join in honoring Dean Galbraith. Convey my good wishes.

From Wm. Lawson, '92, Sterling, Colo.—Very sorry cannot be with you; congratulations to Dean and whole "School." Success to all.

From W. W. Stull, '97, Sudbury.—Unavoidably detained from banquet. Best wishes for continued health and prosperity in your unparallelled devotion to engineering.

From Arthur E. Blackwood, '95, Baltimore, U.S.A.—Con-

gratulations and best wishes from one of the Old Boys who regrets his being unable to be with you.

From L. L. Brown, '95, New York.—Regret deeply inability to be present. Kindly convey my respects and congratulations to Dean Galbraith with best wishes that the evening be a big success.

From G. C. Cowper, '07, Tompkins, Sask.—I deeply regret my inability to be with you to-night to join in honoring our worthy Dean.

From H. S. Carpenter, '97, President Engineering Society, Regina.—Congratulations from "School" graduate members of Regina Engineering Society.

From W. J. Grant, Hamilton.—Please convey to Prof. Galbraith the congratulations and best wishes of an old associate on the Midland Railway in the early seventies.

From T. H. Allison, '92, Bayonne, N.J.—Your New York boys send congratulations and all good wishes.

Letters were received from Frank B. Gilbreth, consulting engineering, New York; Mayor Deacon, of Winnipeg; Sir George W. Ross and Sir John Gibson, and others congratulating the Dean on his anniversary and expressing good wishes for the future.

As a fitting climax and grand finalé to the week-end reunion the Dean and Mrs. Galbraith gave a reception on Saturday afternoon from four o'clock until seven o'clock to the graduates and their wives or friends in the Engineering building. This was marked with equally as great success as was the banquet on the night previous, the characteristic free "School" spirit pervading the four or five hundred present. It afforded a much appreciated opportunity for renewal of acquaintances and many enjoyed dancing to the excellent music rendered by the School orchestra. Dean and Mrs. Galbraith still further kindled the flame of admiration which warmed the hearts of all present toward them.

YOUNG-McINTYRE

Stewart Young, B.A. Sc., '11, surveyor and engineer for the Board of Highway Commissioners, Regina, Sask., was in Toronto for a few days. He was married to Miss McIntyre, of Owen Sound on December 24th, and he and Mrs. Young will return to Regina early in January.

H. L. Seymour, B.A. Sc., '03, who took a post-graduate course last year, was married to Miss Campbell, of Ottawa, on December 3rd. Mr. and Mrs. Seymour attended the University Rugby Dance on December 5th. They will leave for the West in a couple of months.

Other graduates who have lately joined the benedicts are E. M. Salter, '11, K. F. Mickleborough, B.A. Sc., '13, and M. C. Hendry, B.A. Sc., '05. We extend to them our best wishes.

APPLIED SCIENCE

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EDITORIAL

MEETING OF OTTAWA GRADUATES

On Friday afternoon, November 1st, 1913, a meeting of the Ottawa graduates of the "School" was held in the office of Mr. J. B. Challies, '04 of the Waterpower Branch of the Department of Interior, with Mr. Thomas Shanks, '99, a past president of the engineering society, presiding. Those present were E. Richards, F. R. Sims, Geo. E. Stacey, Jas. J. Stock, W. J. Peaker, M. J. C. H. Pinkey, T. Shanks, H. G. Barber, W. F. M. Bryce, J. T. Johnston, T. H. Dunn, O. W. N. Charlton, D. H. Mace, J. B. Challies.

"School" matters were discussed in general, and the "School" Dinner in particular. A committee consisting of Messrs. Shanks, Challies and Stacy was appointed, with power to add to its numbers, to further consider the topics of discussion. At a subse-

quent meeting, the committee reported that they had made an appointment with the Dean for a certain hour on Friday afternoon, December 5th, so that the Ottawa graduates might see him personally to convey their greetings and good wishes to him. The committee are also making the necessary arrangements toward the re-establishment of the custom in vogue a few years ago of having an annual "School" dinner at Ottawa in order that all "School" men in Ottawa may know one another better.

WHAT OUR GRADUATES ARE DOING

R. M. Trow, B.A., Sc., '13, is with the Canadian Copper Co., at Copper Cliff, Ont.

J. W. R. Taylor, B.A., Sc., '08, erecting engineer for the Canadian Westinghouse Co., is at present installing power station equipment at Healey's Falls, Ont. His present address is Campbellford, Ont.

M. E. Crouch, '11, is assistant to H. J. Beatty, '91, engineer and surveyor at Pembroke, Ont.

Howard Webster, B.A., Sc., '13, is taking a post graduate course in architecture at Paris, France.

W. A. M. Cook, B.A., Sc., '06, is structural engineer in the city architects' department, City Hall, Toronto.

W. K. Greenwood, B.A., Sc., '04, is engineer for the Orillia Water, Light and Power Commission, Orillia, Ont.

J. E. A. Moore, C.E., '91, is chief engineer to the C. O. Bartlett & Snow Co., Cleveland, O.

E. D. Monk, B.A., Sc., '08, is district transformer specialist for the General Electric Co., Cincinnati, O.

T. R. C. Flint is power engineer for the Toronto Hydro Electric System.

G. M. Hamilton, B.A., Sc., '11, is assistant engineer on the Welland Ship Canal at the engineer's office, department of railways and canals, Port Colborne, Ont.

L. I. Stone, '10, is resident engineer at the London division of the G. T. Ry., London, Ont.

K. S. MacLachlan, B.A., Sc., '13, is superintendent of Metals Chemical Co., smelters and refiners, Welland, Ont.

W. G. McGhie, B.A., Sc., '11, is in the engineering department of the Canadian Crocker, Wheeler Co., St. Catharines, Ont.

J. I. McSloy, B.A., Sc., '10, is in the textile manufacturing business at St. Catharines.

H. E. Harcourt, '11, is resident engineer in the sewer department, city of Toronto, and also secretary-treasurer of J. H. Tromanhauser Co. Limited, engineers, architects and contractors, 604 Temple Building, Toronto.

W. C. Collett, B.A., Sc., '08, is manager of Collett's Carriage Works, Toronto.

J. P. Rigsby, '01, is with the Turnbull Elevator Works, Toronto.

S (*Continued*)

Spotton, A. K., '94, is chief engineer for Goldie & McCulloch Engine Works, Galt, Ont.

Spry, R. J., '10, is with the B.C. Copper Co. at Nelson, B.C.

Squire, G. E., '11, is fellow in drawing at the Univeristy of Toronto.

Squire, R. H., '93, deceased.

Stamford, W. L., '08, is on the engineering staff of the Hydro Electric Power Co. at Pointe Du Bois, Man.

Starr, R. H., '08, is estimating engineer for the Toronto Hydro Electric system. His address is 670 Indian Rd., Toronto.

Stayner, D. S., '09, of 201 Heath St., W. Toronto, is resident engineer for the Harbor Commission, Toronto.

Steele, I. J., '02, is in the topographical surveys branch of the department of interior at Ottawa, Ont.

Steele, A. L., '10, is superintendent on diamond drill work for the Pierson Engineering Corporation, Worchester, N.B.

Steele, W. S., '11, is with the Brooklyn Rapid Transit Co., Brooklyn, N.Y.

Stern, E. W., '84, is consulting engineer at 101 Park Avenue, New York, N.Y.

Steven, H. M., '10, is mining engineer for the Hollinger Mines, Timmins, Ont.

Stevenson, W. H., '01, address not known.

Stewart, A. E., '11, is a postgraduate student at Massachusetts Institute of Technology, Boston, Mass.

Stewart, J. A., '98, is engineer and contractor, 67 Federal Life Bldg., Hamilton, Ont.

Stewart, D. L. N., '05, address not known.

Stewart, M. A., '05, is assistant engineer in the roadway department at the City Hall, Toronto.

Stewart, R. O., '11, is in the bridge department of the I. R. Co. at Moncton, N.B.

Stewart, W. M., '06, is a member of the firm Phillips, Stewart & Lee, engineers and surveyors, Saskatoon, Sask.

Stewart, G. S., '07, is sales engineer for the Canadian General Electric Co., Toronto.

Stewart, A. W. J., '08, is on the estimating staff of the Hydro-Electric system, 226 Yonge St., Toronto.

Stewart, N. C., '09, is with Green Bros., Burden & Co., Hazelton, B.C.

Stiles, J. A., '07, is professor of civil engineering at University of New Brunswick, Fredericton, N.B.

Stirret, G. P., '08, is resident engineer for C. N. P. Ry., at Spence's Bridge, B.C.

Stiver, J. L., '07, is inspector of gas and electricity with the department of inland revenue, Toronto, Ont.

St. Lawrence, J., '08, is superintendent of engine shops, Erie City Iron Works.

Stock, J. J., '08, is Dominion Land Survey contractor in the Edmonton district. His address is 448 Cooper St., Ottawa.

Stock, P. H., '09, is assistant engineer for the N. St. C. & T. R. railway. His address is 26 Chestnut St., St. Catharines. Ont.

Stocking, F. T., '95, of 74 Kendal Ave., Toronto, is with the Hydro Electric Commission.

Stone, L. J., '10, is resident engineer for the G. T. Railway at London, Ont.

Story, R. A., '11, address not known.

Street, J. C., '09, is in charge of survey of the Welland Ship Canal. Address is either 81 Mackay St., Ottawa, or care of Welland Ship Canal, St. Catharines.

Stroud, S., '09, is sales engineer for the Canadian Westinghouse at Toronto, Ont.

Stuart, H. B., '08, is designer and estimator for the Hamilton Bridge Works Co. Ltd., Hamilton, Ont.

Stuart, J. L. G., '07, '08, is resident engineer on the Civic Car Lines on Gerrard & Coxwell Streets, Toronto.

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